HEWLETT PACKARD

High Speed Low Cost Fiber Optic Transmitter

Technical Data

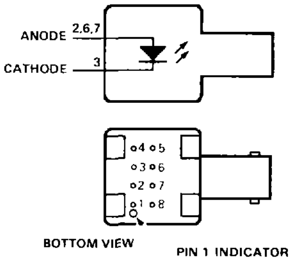
HFBR-14X2 and HFBR-14X4 Series

Description

The HFBR-14XX fiber optic transmitter contains an 820 nm GaAlAs emitter capable of efficiently launching optical power into four different optical fiber sizes: 50/125 µm, 62.5/125 µm, 100/140 µm, and 200 µm PCS. This allows the designer flexibility in choosing the fiber size. The HFBR-14XX is designed to operate with the Hewlett-Packard HFBR-24XX fiber optic receivers.

The HFBR-14XX transmitter's high coupling efficiency allows the emitter to be driven at low current levels resulting in low power consumption and increased reliability of the transmitter. The HFBR-14X4 high power transmitter is optimized for small size fiber and typically can launch −15.8 dBm optical power @ 60 mA into 50/125 µm fiber and −12 dBm into 62.5/125 µm fiber. The HFBR-14X2 standard transmitter typically can couple −11.5 dBm of optical power @ 60 mA into 100/140 µm fiber cable. It is ideal for large size fiber such as 100/140 µm. The high power level is useful for systems where star couplers, taps, or inline connectors create large fixed losses.

Housed Product

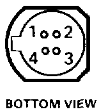


PIN	FUNCTION
1†	N.C.
2	ANODE
3*	CATHODE
4†	N.C.
5†	N.C.
6	ANODE
7*	ANODE
8†	N.C.

*PINS 2,6 AND 7 ARE ELECTRICALLY CONNECTED TO HEADER

†PINS 1, 4, 5 AND 8 ARE ELECTRICALLY CONNECTED

Unhoused Product



PIN	FUNCTION
1	ANODE
2	CATHODE
3	ANODE
4	ANODE

Absolute Maximum Ratings

Parameter		Symbol	Min.	Max.	Units	Reference
Storage Temperature		T_S	−55	+85	°C	
Operating Temperature		T_A	−40	+85	°C	
Lead Soldering Cycle	Temp.			+260	°C	
	Time			10	sec	
Forward Input Current	Peak	I_{FPK}		200	mA	Note 1
	DC	I_{FDC}		100	mA	
Reverse Input Voltage		V_{BR}		1.8	V	

Consistent coupling efficiency is assured by the double-lens optical system (Figure 1). Power coupled into any of the three fiber types varies less than 5 dB from part to part at a given drive current and temperature. The benefit of this is reduced dynamic range requirements on the receiver.

CAUTION: The small junction sizes inherent to the design of this component increases the component's susceptibility to damage from electrostatic discharge (ESD). It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

Electrical / Optical Specifications –40°C to +85°C unless otherwise specified.

Parameter	Symbol	Min.	Typ.[2]	Max.	Units	Conditions	Reference
Forward Voltage	V_F	1.48	1.70	2.09	V	I_F = 60 mA	Figure 9
			1.84			I_F = 100 mA	
Forward Voltage Temperature Coefficient	V_F/T		–0.22		mV/°C	I_F = 60 mA	Figure 9
			–0.18			I_F = 100 mA	
Reverse Input Voltage	V_{BR}	1.8	3.8		V	I_R = 100 μA	
Peak Emission Wavelength	λ_P	792	820	852	nm		Figure 12
Full Width Half Maximum	FWHM		45	75	nm		Figure 12
Diode Capacitance	C_T		55		pF	V = 0, f = 1 MHz	
Optical Power Temperature Coefficient	$\Delta P_T/\Delta T$		–0.006		dB/°C	I = 60 mA	
			–0.010			I = 100 mA	
Thermal Resistance	θ_{JA}		260		°C/W		Notes 3, 8
Numerical Aperture (HFBR – 14X4)	NA_{14X4}		0.31				
Numerical Aperture (HFBR – 14X2)	NA_{14X2}		0.49				
Optical Port Diameter (HFBR – 14X4)	D_{14X4}		150		μm		Note 4
Optical Port Diameter (HFBR – 14X2)	D_{14X2}		290		μm		Note 4

Electrical / Optical Specifications –40°C to +85°C unless otherwise specified

HFBR-14X4 Peak Output Power Measured Out of 1m of Cable

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions		Reference
50/125 µm Fiber Cable NA = 0.20	P_{T50}	–18.8	–15.8	–13.8	dBm	T_A = 25°C	I_F = 60 mA	Notes 5, 6, 9
		–19.8		–12.8				
		–17.3	–13.8	–11.4		T_A = 25°C	I_F = 100 mA	
		–18.9		–10.8				
62.5/125 µm Fiber Cable NA = 0.275	P_{T62}	–15.0	–12.0	–10.0	dBm	T_A = 25°C	I_F = 60 mA	
		–16.0		–9.0				
		–13.5	–10.0	–7.6		T_A = 25°C	I_F = 100 mA	
		–15.1		–7.0				
100/140 µm Fiber Cable NA = 0.30	P_{T100}	–9.5	–6.5	–4.5	dBm	T_A = 25°C	I_F = 60 mA	
		–10.5		–3.5				
		–8.0	–4.5	–2.1		T_A = 25°C	I_F = 100 mA	
		–9.6		–1.5				
200 µm PCS Fiber Cable NA = 0.40	P_{T200}	–4.5	–3.0	+1.5	dBm	T_A = 25°C	I_F = 60 mA	
		–5.5		+2.5				
		–3.0	–1.0	+3.9		T_A = 25°C	I_F = 100 mA	
		–4.6		+4.5				

HFBR-14X2 Peak Output Power Measured Out of 1m of Cable

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions		Reference
50/125 µm Fiber Cable NA = 0.20	P_{T50}	–21.8	–18.8	–16.8	dBm	T_A = 25°C	I_F = 60 mA	Notes 5, 6, 9
		–22.8		–15.8				
		–20.3	–16.8	–14.4		T_A = 25°C	I_F = 100 mA	
		–21.9		–13.8				
62.5/125 µm Fiber Cable NA = 0.275	P_{T62}	–19.0	–16.0	–14.0	dBm	T_A = 25°C	I_F = 60 mA	
		–20.0		–13.0				
		–17.5	–14.0	–11.6		T_A = 25°C	I_F = 100 mA	
		–19.1		–11.0				
100/140 µm Fiber Cable NA = 0.30	P_{T100}	–15.0	–12.0	–10.0	dBm	T_A = 25°C	I_F = 60 mA	
		–16.0		–9.0				
		–13.5	–10.0	–7.6		T_A = 25°C	I_F = 100 mA	
		–15.1		–7.0				
200 µm PCS Fiber Cable NA = 0.40	P_{T200}	–10.0	–6.5	–4.0	dBm	T_A = 25°C	I_F = 60 mA	
		–11.0		–3.0				
		–8.5	–4.5	–1.6		T_A = 25°C	I_F = 100 mA	
		–10.1		–1.0				

WARNING: Obbserving the transmitter output power under magnification may cause injury to the eye. When viewed with the unaided eye, the infrared output is radiologically safe. However, when viewed under magnification, precaution should be taken to avoid exceeding the limits recommended in ANSI Z136.1-1981.

Dynamic Characteristics

Parameter	Symbol	Min.	Typ.[2]	Max.	Units	Conditions	Reference
Rise Time, Fall Time (10% to 90%)	t_r, t_f		4.0	6.5	nsec	I_F = 60 mA No Pre-bias	Note 7, Figure 13
Rise Time, Fall Time (10% to 90%)	t_r, t_f		3.0		nsec	I_F = 10 to 100 mA	Note 7, Figure 11
Pulse Width Distortion	PWD		0.5		nsec		Figure 11

Notes:
1. For I_{FPK} > 100 mA, the time duration should not exceed 2 ns.
2. Typical data at T_A = 25°C.
3. Thermal resistance is measured with the transmitter coupled to a connector assembly and mounted on a printed circuit board.
4. D_T is measured at the plane of the fiber face and defines a diameter where the optical power density is within 10 dB of the maximum.
5. P_T is measured with a large area detector at the end of 1 metre of mode stripped cable, with an ST* precision ceramic ferrule (MIL-STD-83522/13) for HFBR-1412/1414, and with an SMA 905 precision ceramic ferrule for HFBR-1402/1404. This approximates a standard test connector.
6. When changing µW to dBm, the optical power is referenced to 1 mW (1000 µW). Optical Power P (dBm) = 10 log P (µW)/ 1000 µW.
7. Pre-bias is recommended if signal rate > 10 MBd, see recommended drive circuit in Figure 11.
8. Pins 2, 6 and 7 are welded to the anode header connection to minimize the thermal resistance from junction to ambient. To further reduce the thermal resistance, the anode trace should be made as large as is consistent with good RF circuit design.
9. Fiber NA is measured at the end of 2 metres of mode stripped fiber, using the far-field pattern. NA is defined as the sine of the half angle, determined at 5% of the peak intensity point. When using other manufacturer's fiber cable, results will vary due to differing NA values and specification methods.

FIBER OPTICS

Recommended Drive Circuits

The circuit used to supply current to the LED transmitter can significantly influence the optical switching characteristics of the LED. The optical rise/fall times and propagations delays can be improved by using certain circuit techniques.

The LED drive circuit shown in Figure 11 uses current-peaking to reduce the typical rise/fall times of the LED and a small pre-bias voltage to minimize propagation delay differences that cause pulse-width distortion. The circuit will typically produce rise/fall times of 3 ns, and a total jitter including pulse-width distortion of less than 2 ns. This circuit is recommended for applications requiring low edge jitter or high-speed data transmission at signal rates of up to 125 MBd. Component values for this circuit can be calculated for different LED drive currents using the equations shown below.

For additional details about LED drive circuits, the reader is encouraged to read Hewlett-Packard Application Bulletin 78 and Application Note 1038.

$$R_y\ (\Omega) = \frac{(V_{CC} - V_F) + 3.97\ (V_{CC} - V_F - 1.6\ V)}{I_{F_{ON}}\ (A)}$$

$$R_{x_1}\ (\Omega) = \frac{1}{2}\left(\frac{R_y}{3.97}\right)$$

$$R_{EQ_2}\ (\Omega) = R_{x_1} - 1$$

$$R_{x_2} = R_{x_3} = R_{x_4} = 3\ (R_{EQ_2})$$

$$C\ (pF) = \frac{2000\ (ps)}{R_{x_1}\ (\Omega)}$$

Example for $I_{F_{ON}}$ = 100 mA: V_F can be obtained from Figure 9 (= 1.84 V)

$$R_y = \frac{(5 - 1.84) + 3.97\ (5 - 1.79 - 1.6)}{0.100}$$

$$R_y = \frac{3.16 + 6.39}{0.100} = 95.5\ \Omega$$

$$R_{x_1} = \frac{1}{2}\left(\frac{R_y}{3.97}\right) = 12.0\ \Omega$$

$$R_{EQ_2} = 12.0 - 1 = 11.0\ \Omega$$

$$R_{x_2} = R_{x_3} = R_{x_4} = 3\ (11.0) = 33.0\ \Omega$$

$$C = \frac{2{,}000\ pS}{12.0\ \Omega} = 167\ pF$$

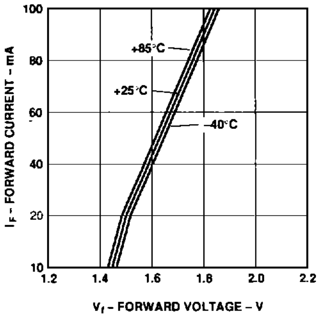


Figure 9. Forward Voltage and Current Characteristics.

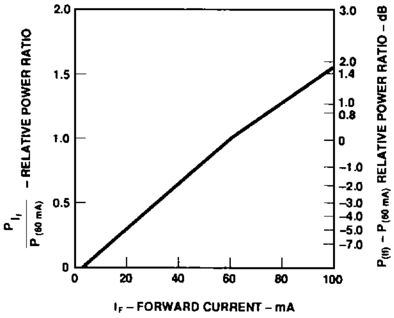


Figure 10. Normalized Transmitter Output vs. Forward Current.

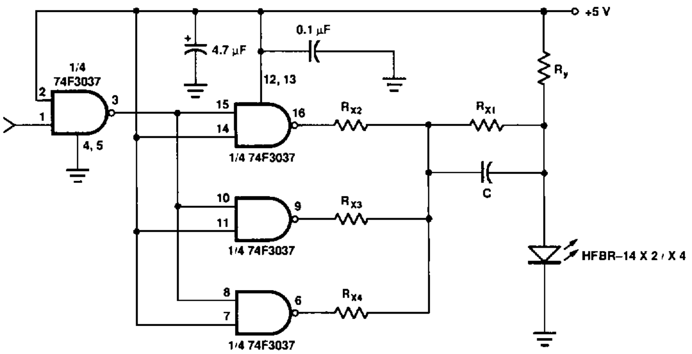


Figure 11. Recommended Drive Circuit.

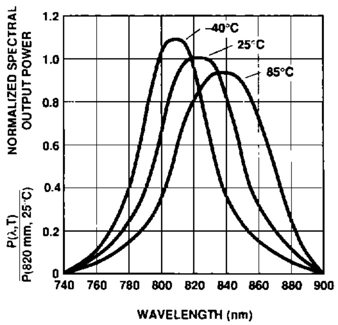


Figure 12. Transmitter Spectrum Normalized to the Peak at 25°C.

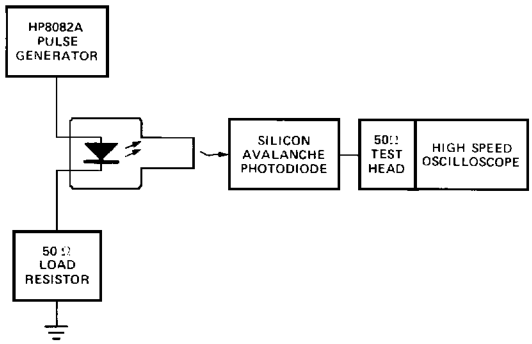


Figure 13. Test Circuit for Measuring t_r, t_f.